# Structuralist explications of dialectics

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*Published in:*
EPRINTS-BOOK-TITLE



*Publication date:*
1991

# STRUCTURALIST EXPLICATIONS OF DIALECTICS

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## *1. Introduction*

Although Professor Weingartner has mainly worked on problems which are of direct interest to analytic philosophers, in several of his publications he has also undertaken the enterprise of an "analytic reconstruction of non-analytic concepts". Weingartner (1974) and (1987) are good examples, dealing with the explication of traditional problem formulations in the philosophy of religion and ethics. This contribution deals with a traditional style of philosophizing on which Weingartner has, as far as I know, not practiced his impressive analytical skills, viz. dialectics.

I will explicate a set of related dialectical concepts: "dialectical negation", "dialectical correspondence", "double negation", "thesis-antithesis-synthesis", "the absolute". I do not claim to state the last word about these concepts, on the contrary, the only aim is to give the most naive elaboration of a new perspective onto them. In doing so, I have two purposes in mind. On the one hand I want to show to analytic philosophers that it is possible to make good sense of dialectical phrases. In this respect my position is, as far as formal aspects are concerned, quite opposite to the famous attack of dialectics by Popper (1963). On the other hand I hope that my excercises have some appeal to formally interested dialecticians, such that they become motivated to undertake refined explications that serve their purposes better. This second, limited purpose also explains why I will not attempt to support my explications with telling quotations of classical dialectical philosophers. For the present, the only important thing is some elementary idea of the kind of intuitions that seem to be involved.

The new perspective on dialectical concepts is provided by the so-called structuralist approach to the problem of verisimilitude or truthlikeness, i.e. the problem of explicating the idea that one theory is closer to the truth than another. It should be mentioned that Gerhard Schurz and Paul Weingartner (1987) have shown convincingly that Popper's failing attempt to solve this problem can be repaired within the statement approach by restricting to so-called relevant consequences. Nevertheless I prefer the structuralist theory of truthlikeness, which I started in (Kuipers, 1982), for a lot of problem specific reasons. It would lead

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* I'd like to thank Jeroen Bartels, Bert Hamminga, Peter Kirschenmann, Jasper Oosten and Jeanne Peijnenburg for their comments on an earlier version.

too far to expose them here; see Miller (1990) for an interesting review article on both mentioned and some other approaches. The structuralist theory of truthlikeness has generated a number of unexpected and unintended results. The most important ones are:

- a precise explication of Popper's bad luck, i.e. the convincing failure of his at first sight very plausible definition of truthlikeness (Kuipers, 1982, 1987a),
- a justification of fundamental methodological rules, in particular the rule to choose the most successful theory (Kuipers, 1982, 1984, 1987a, 1989),
- an explanation of the success of the natural sciences in terms of truth approximation (Kuipers, 1989),
- an explication of the correspondence theory of truth as an intralevel intuition (Kuipers, 1987c).

However, the most unintended result is an explication of dialectical concepts, and even that is suggesting itself from the structuralist theory of truthlikeness.

The structuralist point of view applied to the problem of truthlikeness immediately leads to the recognition that there are essentially two problems of truthlikeness: descriptive truthlikeness, related to the actual world, represented by one particular structure, and theoretical truthlikeness, related to the set of empirical possibilities, represented by a set of structures. Hence, there is a descriptive and a theoretical level or perspective. It turns out to be possible to explicate the main dialectical concepts on both levels in three different ways. More specifically, on both levels there are formally resembling (epistemo-)logical readings as well as formally resembling ontological readings of the notions. *Section 2* deals with those on the descriptive level, *Section 3* with those on the theoretical level. Moreover, on both levels there are in addition interesting methodological readings (*Section 4*), which mutually differ in a very interesting way.

In order to minimize the formal duplication of *Sections 2* and *3*, I conclude this section with some crucial set-theoretic concepts. Let $A, B$, etc. indicate arbitrary subsets of some fixed universe of discourse ($UD$). We start with some standard definitions. The set of all members of $A$ not belonging to $B$ is indicated by $A–B$, and is called the (asymmetric) *difference* of $A$ and $B$. The *complement* $C(A)$, or simply $CA$, of a set $A$ is defined as $UD–A$. The *symmetric difference* of $A$ and $B$ is defined as the union of $A–B$ and $B–A$, and is indicated by $A \Delta B$. Both difference concepts are depicted in *Figure 1*.

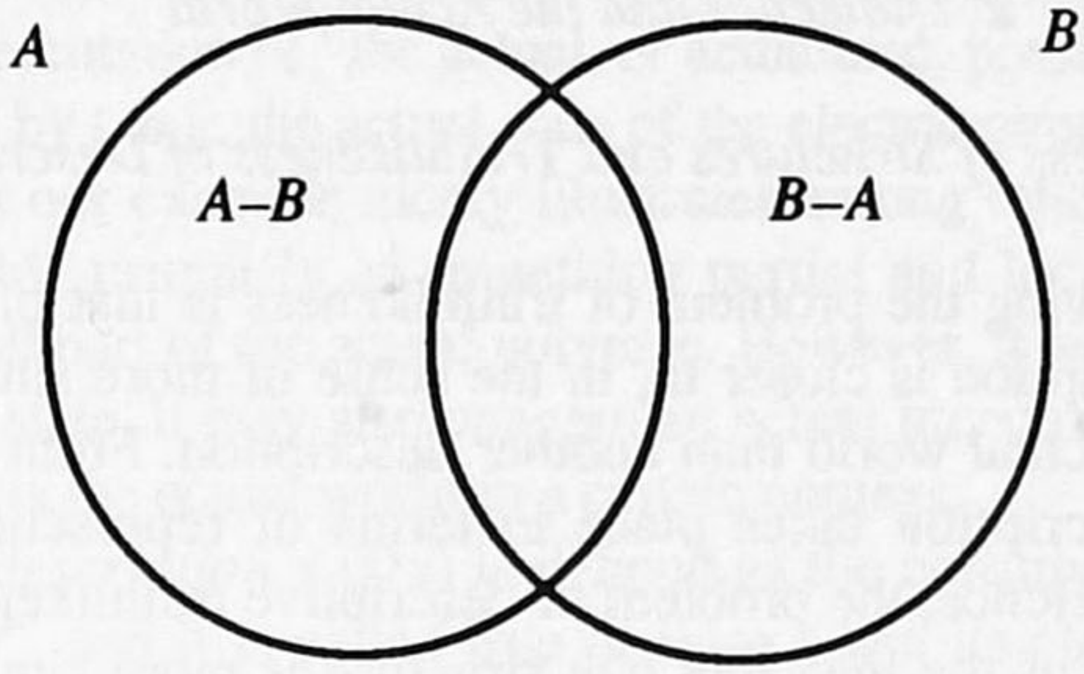


*Figure 1*

The crucial non-standard notion is that of comparative similarity between sets.

*Definition*:

1. *B* is *at least as similar* to *C* as *A* iff (if and only if)
   *C–B* is a subset of *C–A* and *B–C* is a subset of *A–C*.
2. *B* is *more similar* to *C* than *A* iff
   *B* is at least as similar to *C* as *A*, and at least one of *C–B*, *B–C* is a proper subset of *C–A*, *A–C*, respectively.

It is easy to check that this definition can also be expressed in terms of the notion of symmetric difference, viz. B Δ C is a (proper) subset of A Δ C. Hence, the definition captures the following plausible interpretation of increasing similarity between sets: the set of elements of *UD* with respect to which *B* and *C* differ is a (proper) subset of those with respect to which *A* and *C* differ. The situation is depicted in *Figure 2*, in which, like in later figures, shaded areas are empty, and at least one of the two starred areas is non-empty.

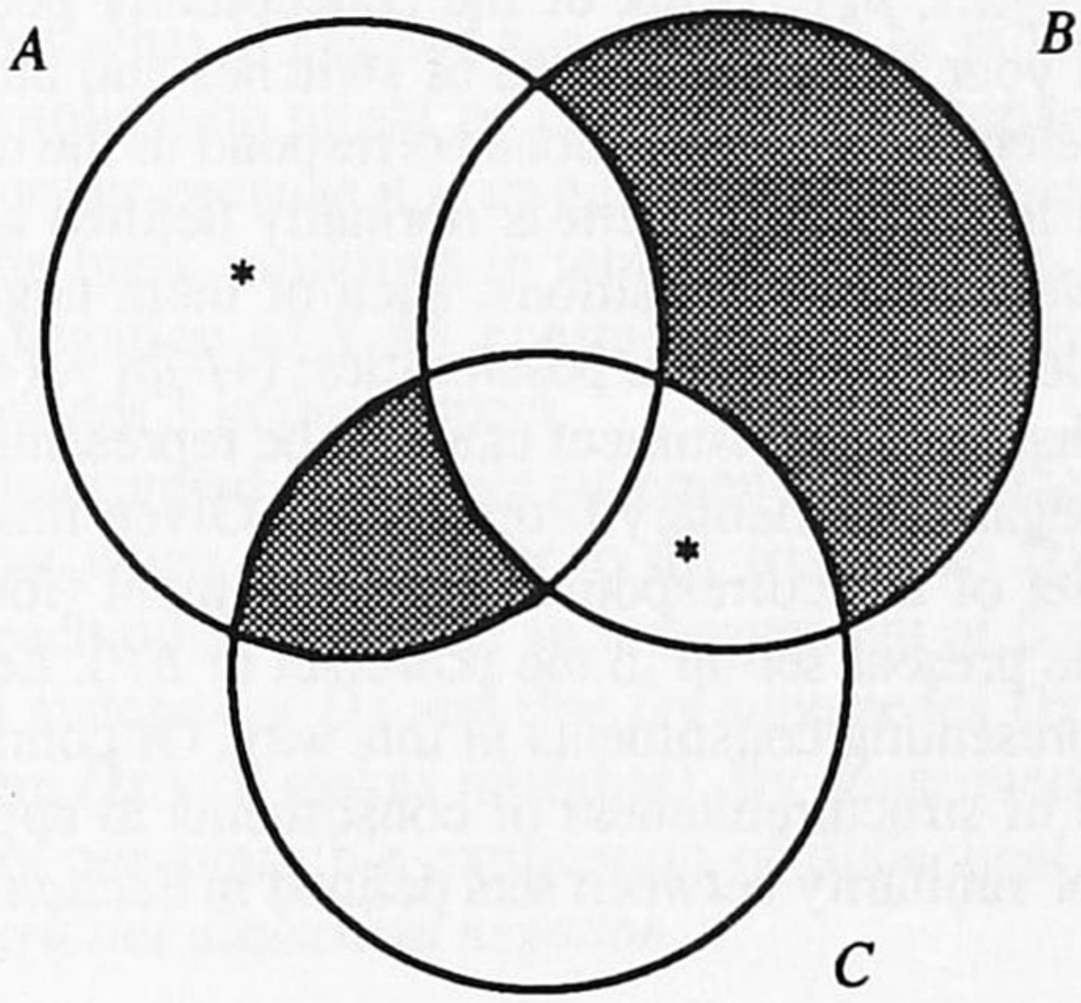


*Figure 2*

## 2. *Dialectics and the Actual World*

### 2.1. *Likeness of Structures and Truthlikeness of Descriptions*

One way of conceiving the problem of truthlikeness is that of explicating the idea that one description is closer to, in the sense of more similar to, the true description of the actual world than another description. From the structuralist point of view, description takes place in terms of representation by a set-theoretic structure. Hence, the problem of descriptive truthlikeness requires the general explication of the idea that one structure is more similar to a second than a third: comparative likeness of structures or structurelikeness. Having done this, the correct or true representation of the actual world may be substituted for the second structure to get the core of comparative truthlikeness of (structure-)descriptions.

There are a number of *prima facie* different kinds of structures, e.g. propositional, first order and real number structures. There does not seem to be one general explication of structurelikeness for all these kinds of structures, but the explications have strong formal resemblance. One important general presupposition of these explications is that the relevant universe of discourse of *conceptual possibilities* are structures of a certain kind belonging to a fixed so-called similarity type. A universe of discourse of this kind will be called a *conceptual space* (*CS*). An example of a similarity type of (first order) structures is for instance all structures of the form $\langle D, R \rangle$, where $R$ is a binary relation on a set (domain) $D$; the notion of similarity type should not be confused with one of the similarity notions defined in this paper.

Here we will restrict ourselves to the propositional structures, also called propositional constituents, generated by a fixed finite set of elementary propositions: $EP = \{p_1, p_2, \ldots, p_n\}$. Think of the conceptually possible states of the electric circuit in your home constituted of switches and bulbs connected with wires, where the elementary propositions correspond to the claims that switches are on and bulbs light. A constituent is normally defined as an arbitrary conjunction of the elementary propositions, each of them negated or unnegated, leading to the following conceptual possibilities: $(+/-)p_1 \wedge (+/-)p_2 \wedge \ldots \wedge (+/-)p_n$. It is easy to see that such a constituent can also be represented, for example, by the set of its unnegated elementary propositions. Given this way of representation, every subset of *EP* corresponds to a constituent (for which reason *CS* corresponds in the present set-up to the powerset of *EP*). Let $x$, $y$, etc. indicate subsets of *EP* representing constituents in this way. Of course we now propose for the definition of structurelikeness of constituents to apply the general set-theoretic notion of similarity between sets defined in *Section 1*.

We arrive at truthlikeness of (structure-)descriptions by assuming that there is one correct representation of "the actual, or actualized, possibility" or *the actual world*, indicated by $t$, e.g. the actual state of the electric circuit in your home.

Note first that our example nicely illustrates among others that we consider "the actual world" primarily as something partial and local, i.e. one or more aspects of a small part of the actual universe. However, it need not be restricted to a momentary state, it may also concern an actual trajectory of states. In sum, the actual world is the actual world in a certain context.

An arbitrary *description* $x$ ($Dx$) is defined as the constituent $x$ together with the claim "$x = t$", and it is called true or false when its claim is true or false, respectively. Notice that there is just one true description, viz. $Dt$, also called *the* (*descriptive*) *truth*. Of course we define now that $Dy$ is closer to the truth than $Dx$ iff $y$ is more similar to $t$ than $x$. Recall that the formal situation is depicted in *Figure 2*.

When the claim of a description is true or false with respect to a particular elementary proposition, that proposition is called a (descriptive) "match" or "mistake" of the description, respectively. Now it is easy to check that $Dy$ is closer to the truth than $Dx$ iff the set of matches of $Dy$ properly includes that of $Dx$ or, equivalently, iff the set of mistakes of $Dy$ is a proper subset of that of $Dx$.

### *2.2. Dialectical Approach of the True Description of the Actual World: Logical Version*

Let us start with one of the main dialectical concepts. The idea of *dialectical negation* seems to be composed of at least three partial intuitions: contradicting, incorporating and superseding what is negated. Note that "superseding what is negated" implies that what is negated has to be false or at least cannot be the whole truth. This implication might be considered as a separate intuition, but we will neglect it further because it is implied by the three basic intuitions. We will now specify the basic intuitions in terms of statements. When statement $S^*$ is a dialectical negation of $S$, $S^*$ contradicts $S$, it incorporates what was good of $S$ and supersedes $S$ in this respect.

Descriptions, as interpreted above, are statements, due to their claims. Now it is easy to check that when $Dy$ is closer to the truth than $Dx$, they (i.e. their claims) contradict each other and $Dy$ is an improvement of $Dx$ in the sense that $Dy$ incorporates all matches of $Dx$ and that $Dy$ supersedes $Dx$ by having some extra matches (where $Dx$ still makes mistakes). By consequence, "closer to the descriptive truth" is one plausible explication of dialectical negation, which might be called *descriptive dialectical negation*.

One possible objection against this explication is that there will be in general more than one description closer to the truth than a given one, whereas dialectical negation may have the connotation of uniqueness and that for this reason the explication is more appropriate for the related idea of *dialectical correspondence*. However this may be, it is important to note that most descriptions are not closer to the truth than a given one and that there is room for supplementary intuitions.

In the line of the foregoing it is now also plausible to explicate the idea of *double negation* as the combination of two successive descriptive dialectical negations, leading to a stepwise improvement of descriptions: $Dx \rightarrow Dy \rightarrow Dz$, i.e. from $Dx$ to $Dz$ with $Dy$ as intermediate. It is easy to check that dialectical negation is an asymmetric and transitive relation. By consequence, the present explication of double negation of the triple $\langle Dx, Dy, Dz\rangle$ could also be interpreted as an *asymmetric* explication of the famous triad: thesis, antithesis, synthesis, for the permuted triple $\langle Dx, Dy, Dz\rangle$ would not satisfy the double negation conditions.

In my opinion the following *symmetric* explication of *thesis-antithesis-synthesis* is more plausible. Suppose that $Dx$ and $Dy$ are incomparable in the sense that none of the two is closer to the truth than the other, implying not only that they contradict each other but also that both have "pro's and con's" with respect to each other. Suppose further that $Dz$ is closer to the truth than, and hence a dialectical negation of, $Dx$ as well as $Dy$. By consequence, $Dz$ incorporates all common and non-common merits of the two, such that it improves upon both. This seems the core of the triad: the synthesis contradicts, incorporates and supersedes thesis and antithesis, which contradict each other as equals. Hence, the present explication is symmetric between $Dx$ and $Dy$, for $\langle Dx, Dy, Dz\rangle$ satisfies the conditions if and only if $\langle Dx, Dy, Dz\rangle$ satisfies them, apart from a possible implicit time order.

At the end of this "first dialectical round" it is tempting to qualify "$t$" as *the absolute*, although it is relative to the conceptual space. This evokes the intriguing question whether there is, for some or all scientific contexts, something like an ideal or optimal conceptual space, with corresponding descriptive truth. Of course, the burden of proof is to those who think so.

Notice that the explications of truthlikeness and dialectics of descriptions could have been relativized by replacing $Dt$ by some $Dz$, and hence by the conditional statement: suppose that $Dz$ is the true description, i.e. suppose $z = t$, then... etc.

Given the restriction of the foregoing explication to knowledge claims about the actual world it may be called epistemological dialectics with respect to the actual world. However, to evaluate the fundamental statement that one description is closer to the descriptive truth than another presupposes that we know the true description. Hence, the explication is primarily a logical exercise,

for in scientific practice we will not know the true description. When we are describing the actual world, e.g. the conditions and outcome of an experiment, we are aiming at the true description of the relevant actual world. In *Section 4* we will introduce a related alternative to the present epistemo-*logical* explication which has not only logical but also methodological relevance.

### *2.3 Dialectical Development of the Actual World*

Dialectics is something of which it is not only said that it applies to knowledge claims (above and below) and concepts (below), but also to reality, in particular to the development of the actual world, which might be called ontological dialectics of the actual world. It is now plausible to focus on successive actual states of the world and attach indices, indicating successive moments of time, to the momentary true representation $t$, leading to: $t_1$, $t_2$,....

We begin by relativizing all judgments to an arbitrary later state. In the light of $t_3$, $t_2$ is a dialectical negation of (or dialectically corresponds to) $t_1$ iff $t_2$ is more similar to $t_3$ than $t_1$. In the light of $t_4$, $t_3$ is a double negation of $t_1$ with $t_2$ as intermediate iff $t_2$ is more similar to $t_4$ than $t_1$ and $t_3$ is more similar to $t_4$ than $t_2$. In the light of $t_4$, $\langle t_1, t_2, t_3\rangle$ is a (symmetric) thesis-antithesis-synthesis-triad iff $t_3$ is more similar to $t_2$ than $t_1$ as well as $t_2$, whereas $t_2$ is not more similar to $t_4$ than $t_1$, nor the converse.

These qualifications of developments get an absolute character when there is supposed to be something like a final, albeit conceptually relative, state, the absolute, in the light of which all judgements are made.

## *3. Dialectics and Empirical Possibilities*

### *3.1. Likeness of Sets of Structures and Truthlikeness of Theories*

The second way of conceiving the problem of truthlikeness is that of explicating the idea that one theory is closer to, in the sense of more similar to, the true theory about what is empirically possible than another theory. In the structuralist approach theories are formulated in terms of sets of structures. Hence, the problem of theoretical truthlikeness requires the general explication of the idea that one set of structures is more similar to a second than a third: comparative likeness of sets of structures. Given such an explication, the set of empirical possibilities may be substituted for the second set of structures to get the core of truthlikeness of theories. From the structuralist point of view the present problem of truthlikeness is the most important one, for theory directed

empirical sciences are not so much interested in the actual world but in what is empirically possible.

Unlike the situation on the descriptive level there is on the theoretical level no reason to restrict the exposition to a particular kind of structures. We will only assume again that there is a fixed set of structures of a certain similarity type, the conceptual possibilities, constituting the conceptual space *CS*. Let *X*, *Y*, etc. indicate subsets of *CS*. For the general definition of likeness of sets of structures we propose of course again to apply the general set-theoretic notion of similarity between sets defined in *Section 1*.

Theory-directed empirical sciences are supposed to be aiming at the characterization of the subset of empirically possible worlds or *empirical possibilities*, indicated by *T*. Think of the set of empirically possible states of the circuit in your home, which now illustrates the limited character of our empirically possible worlds. The problem of truthlikeness of theories gets now the following explication. Define an arbitrary *theory X* (*TX*) as the subset *X* together with the claim "*X* = *T*" and call a theory true or false when its claim is true or false, respectively. Now there is just one true theory, viz. *TT*, called *the* (*theoretical*) *truth*. Of course we define now that *TY* is closer to the truth than *TX* iff *Y* is more similar to *T* than *X*, which is again formally depicted in *Figure 2*. When the claim of a theory is true or false with respect to a particular conceptual possibility this possibility is called a (theoretical) "match" or "mistake" of that theory, respectively. It is easy to check that in this terminology *TY* is closer to the truth than *TX* iff the set of matches of *TY* properly includes the set of matches of *TX* or, equivalently, iff the set of mistakes of *TY* is a proper subset of that of *TX*.

### *3.2. Dialectical Approach of the True Theory about the Empirical Possibilities: Logical Version*

*Section 2.2* dealt with the epistemological explication of dialectic concepts on the level of descriptions. The explication on the level of theories and its motivation, now in terms of theoretical matches and mistakes, are completely analogous. We just state the results: *TY* is a (theoretical) dialectical negation of *TX* (or *TY* dialectically corresponds to *TX*) iff *TY* is closer to the truth than *TX*, *TZ* is a double negation of *TX* with *TY* as intermediate iff *TY* is closer to the truth than *TX* and *TZ* is closer to the truth than *TY*. *TZ* is a synthesis of the thesis *TX* and the antithesis *TY* iff *TZ* is closer to the truth than *TX* as well as *TY*, but *TY* is not closer to the truth than *TX*, nor the converse. Finally, *TT* is the (conceptually relative) absolute.

When dialecticians suggest that the scientific enterprise is a dialectical process the just presented theoretical notions may be more appropriate to characterize

this process than the descriptive notions. It is also in this perspective that the dialectics of statements can be seen to be also a dialectics of concepts. For a theory $X$ is supposed to be specified as a subset of conceptual possibilities: those members of $CS$ that satisfy certain conditions. In other words, $X$ can also be conceived as the extension of a set-theoretic predicate and hence as the extension of a concept. By consequence, the dialectics of theories can also be conceived of as a dialectics of concepts.

Notice again that the explications of truthlikeness and dialectics of theories could have been relativized by replacing $TT$ by some $TZ$, and hence by the conditional statement: suppose that $TZ$ is the true theory, i.e. suppose $Z = T$, then ... etc.

The explications are again (epistemo-)logical in the sense that the evaluation of the crucial statement that one theory is closer to the (theoretical) truth than another presupposes that one knows the true theory, which is far from scientific practice. However, in *Section 4* we will show that there is again a methodologically relevant alternative, which differs in an interesting way from the methodological version of the epistemological approach of the actual world.

### *3.3 Dialectical Development of the Set of Empirical Possibilities*

Formally, it is no problem to formulate analogous to the descriptive case an ontological variant of the epistemological explication on the theoretical level. Suppose that $T$, i.e. the set of empirical possibilities, changes in time, leading to the sequence $T_1, T_2, \ldots$ of subsets of $CS$.

Again we begin by relativizing all judgments to an arbitrary later moment. In the light of $T_3$, $T_2$ is a dialectical negation of $T_1$ iff $T_2$ is more similar to $T_3$ than $T_1$. In the light of $T_4$, $T_3$ is a double negation of $T_1$ with $T_2$ as intermediate iff $T_2$ is more similar to $T_4$ than $T_1$ and $T_3$ is more similar to $T_4$ than $T_2$. In the light of $T_4$, $\langle T_1, T_2, T_3\rangle$ is a thesis-antithesis-synthesis-triad iff $T_3$ is more similar to $T_4$ than $T_1$ as well as $T_2$, whereas $T_2$ is not more similar to $T_4$ than $T_1$, nor the converse.

These qualifications of developments get again an absolute, though $CS$-relative, character when there is supposed to be something like a final set of empirical possibilities, the absolute, in the light of which all judgements are made.

An important problem with both ontological readings on the theoretical level is that it presupposes that the set of empirical possibilities changes. If one equates "empirically possible" with "physically possible" this implies the assumption that the laws of nature may change, a very problematic assumption indeed. However, in several contexts it makes good sense to distinguish levels of empirical possibility, as e.g. suggested by the following sequence of "lower"

to "higher" levels: the physical, chemical, biological, psychological, cultural-socio-economical level. Being empirically possible at a higher level then implies being empirically possible at a lower level, but not the converse. Another example concerns the idea of empirically possible states of an artifact, e.g. the electric circuit in your home, assuming that it remains intact, which means a severe restriction to its physically possible, including broken, states. Assuming such a hierarchy of levels of empirical possibilities it may make sense to assume that the set of empirical possibilities at some higher level may change without change of the empirical possibilities at the lower levels. For this line of thought it is only necessary that in stable periods the boundaries between the different levels of empirical possibility can be defined more or less sharply.

## *4. Methodological Approaches*

The epistemological explications of truthlikeness and dialectics of descriptions and theories were a priori or logical in the sense that the relevant judgements presupposed to know the (whole) descriptive and the theoretical truth, respectively. For both levels there are methodological alternatives, which do not presuppose to know the whole truth. At successive stages an increasing part of the truth is supposed to become known, in terms of which the success and the problems of a description or theory are defined, as well as the comparative judgement that one description or theory is more successful than another. Due to the different nature of descriptive and theoretical claims the explication on both levels will differ substantially. Whatever these differences are, it will be clear that the comparative success judgements can be methodologically relevant, in the sense that they may guide the choice between descriptions and theories, respectively. Hence, the corresponding methodological explications of dialectics may even be more appropriate for the scientific process.

### *4.1 Dialectical Approach of the True Description of the Actual World: Methodological Version*

#### *4.1.1 The (Established) Success of Descriptions*

On the descriptive level we will again restrict our attention to propositional descriptions. Let us also suppose that actual descriptions are not presented in a piecemeal way, but in total (as far as the relevant elementary propositions are concerned). Think of the descriptions resulting from one or more researchers or mechanical description devices. To evaluate such descriptions we assume the idealization of an infallible meta-position.

Let $p(t)$ and $n(t)$ indicate the (mutually exclusive) sets of elementary propositions of which it has been established at time $t$ (not to be confused with the descriptive truth!) that its truth value is "true" (positive) or "false" (negative), respectively. Together $p(t)$ and $n(t)$ are called the available data at $t$. In the course of time both sets can of course only grow, not shrink. Consider now the description $x$, i.e. $Dx$. The union of $p(t) \cap x$ and $n(t) \cap Cx$ indicates the set of elementary propositions about which it has been established that $Dx$ makes correct elementary claims, called the established matches, and the union of $p(t)$–$x$ and $n(t)$–$Cx$ indicates the set of elementary propositions about which it has been established that $Dx$ makes elementary mistakes, called the established mistakes. Now it is plausible to define that $Dy$ is more successful at time $t$ than $Dx$ iff the set of established matches of $Dy$ properly includes that of $Dx$, or, equivalently, iff the set of establised mistakes of $Dy$ is a proper subset of that of $Dx$, formally:

*Definition*:
$Dy$ is more successful at $t$ than $Dx$ iff
$p(t)$–$y$ is a subset of $p(t)$–$x$, and
$n(t)$–$Cy$ is a subset of $n(t)$–$Cx$,
and at least one of both subsets is a proper subset.

This definition can also be phrased in symmetric differences, but this does now not clarify much. The situation is depicted in *Figure 3*, where the descriptive truth $t$ is indicated by a bold line.

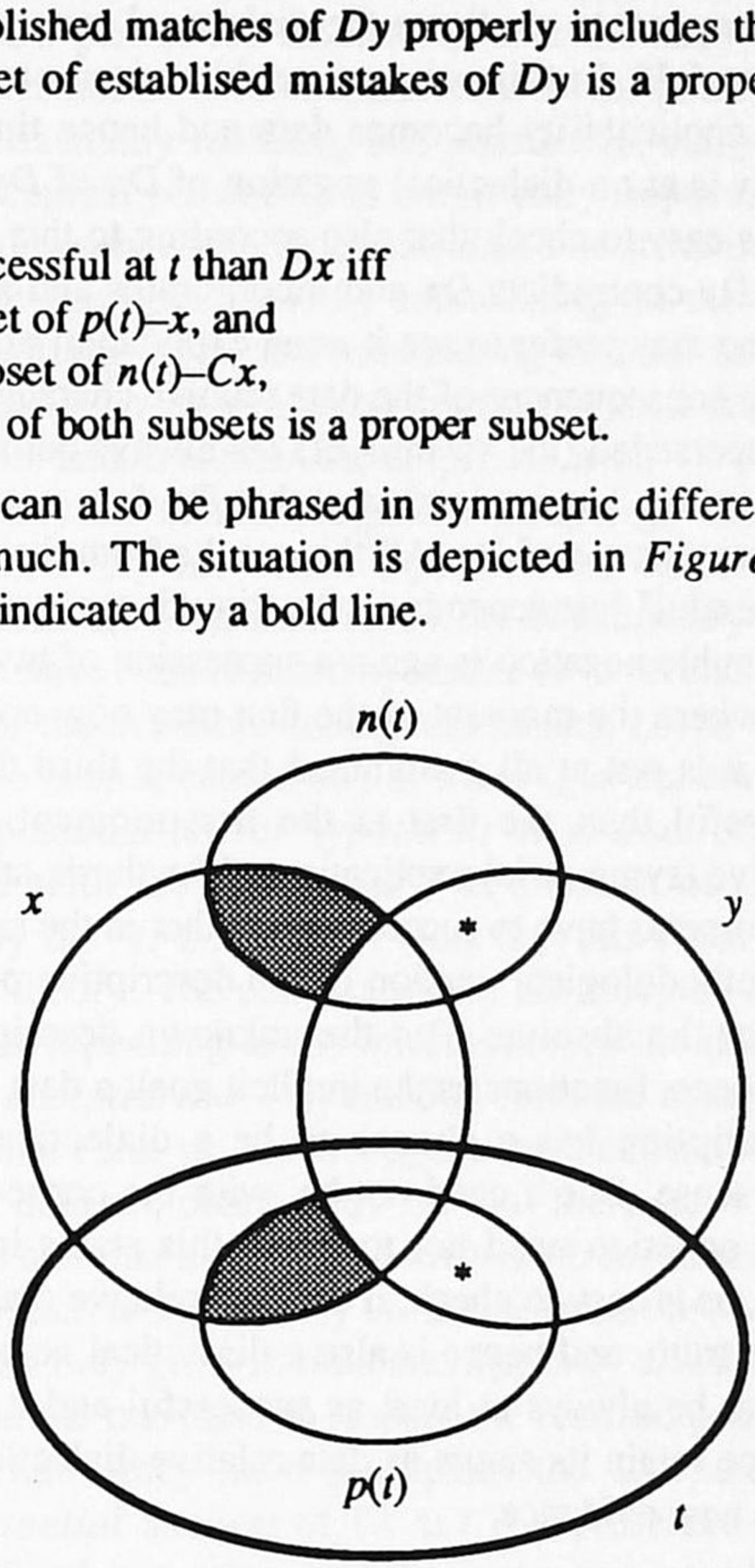


*Figure 3*

Notice that the "success" of a description is completely symmetric with respect to true and false elementary propositions. When we can establish that such a proposition is true when it is true, we can also establish that it is false when it is false, and vice versa. For this reason we call the present notion of success symmetric. On the theoretical level the success of theories will appear to be first of all an asymmetric notion.

### *4.1.2 Dialectics of Descriptions on the Basis of Their Success*

Of course we now suggest to explicate the dialectical concepts in terms of the notion "more successful". In this way we get historized explications of these concepts, for their applicability becomes data and hence time relative. In the light of $p(t)/n(t)$, $Dy$ is at $t$ a dialectical negation of $Dx$ iff $Dy$ is more successful than $Dx$ at $t$. It is easy to check that also according to this data relative comparative statement $Dy$ contradicts $Dx$ and incorporates and supersedes what is good of it. Again one may prefer to see it as an explication of dialectical correspondence. The main consequences of the data relative character are that $Dy$ does not need to have superseded (the success of) $Dx$ always before $t$ (it might have been equal till some time, but not less), and that $Dy$ does not need to be able to incorporate the future success of $Dx$. All this results from the fact that the qualification "more successful" just depends on the (growing) momentary data-sets.

A data relative double negation is again a succession of two data relative dialectical negations, where the moment of the first may now not be later than that of the second. For it is not at all guaranteed that the third description was already more successful than the first at the first moment. In the otherwise plausible data relative (symmetric) explication of the thesis-antithesis-synthesis-triad the relevant moments have to succeed each other in the same order.

In the present methodological version of the descriptive perspective there is no explicit place for the absolute. But the unknown descriptive truth $t$, apart from its $CS$-dependence, functions as the implicit goal: a data relative dialectical negation of a description has a chance to be a dialectical negation in the (epistemo-)logical sense. But it need not be, with the consequence that a data relative dialectical negation need not to retain this status in the light of new evidence. However, as is easy to check, if the data relative dialectical negation is indeed closer to the truth, and hence is also a dialectical negation in the logical sense, then it had to be always at least as successful and it will remain more successful and hence retain its status as data relative dialectical negation in the light of all possible new evidence.

## *4.2 Dialectical Approach of the True Theory about the Empirical Possibilities: Methodological Version*

### *4.2.1 The Success of Theories*

Far from being known, the theoretical truth $T$ is in theory directed empirical sciences the great unknown. In the propositional form of the descriptive case we saw that the (descriptive) truth could be gradually established by establishing the truth-value of more and more elementary propositions. This process was seen to be essentially symmetric between true and false propositions. The important difference between the descriptive and the theoretical case arises from the fact that coming to know part of the theoretical truth normally is something asymmetrical: you can establish that a certain conceptual possibility is empirically possible by experimentally realizing this possibility, but you cannot establish that a certain conceptual possibility is empirically *im*possible in a direct way, for you cannot realize empirical *im*possibilities. The standard (partially) indirect way to circumvent this problem is by establishing on the one hand empirical possibilities by realizing them, and establishing on their basis (empirical) laws on the other. The theories are evaluated in terms of their capacity to respect the realized possibilities and to explain the empirical laws.

Hence, technically all methodological concepts go back to the following crucial concept: at every moment $t$ (again not to be confused with the descriptive truth!) there has been described a set of *realized possibilities* $R(t)$, i.e. possibilities which have been realized by nature or experiment and have been described in terms of the available conceptual means, i.e. as members of $CS$. On its basis there have been accepted one or more (general empirical) laws. In the present set-up a potential law or *hypothesis* $H$ is a set of conceptual possibilities $H$ together with the claim that $T$ is a subset of $H$, i.e all empirical possibilities satisfy the "*H-condition*". Note that this claim is half of the claim associated with a theory. The conjunction of all accepted laws at time $t$ is the hypothesis $S(t)$ corresponding to the intersection of the relevant sets, and is in fact *the strongest accepted law*. $R(t)$ and $S(I)$ form the *data* with which a theory is confronted at time $t$ and we assume again the idealization that we are infallible as far as the data are concerned, i.e. that there have not been made descriptive mistakes and that all accepted laws are true: hence, $R(t)$ is a subset of $T$ and $T$ of S(t), whatever $T$ precisely is. In line with this, we assume the idealization that $R(t)$ can only grow in time and $S(t)$ only shrink.

Theories have at the one hand to respect the realized possibilities (instances) and at the other hand they have to explain the accepted laws as much as possible. The *instantial success* of $TX$ at $t$ is represented by the intersection $R(t) \cap X$, the realized examples, and the *instantial problems* by $R(t)–X$, the realized counterexamples. It is plausible to define that $TX$ is instantially more

successful than *TY* by the requirement that the instantial success of *TX* is a proper subset of that of *TY*. It is easy to prove that this is equivalent to the requirement that the instantial problems of *TY* form a proper subset of those of *TX*.

The *explanatory success* of a theory consists of the explained laws, and the unexplained laws form the *explanatory problems*. In the present set-up all laws which have implicitly been accepted can be represented by the set of all sets of which $S(t)$ is a subset, indicated by $L(t)$. On the other hand, all hypotheses following from *TX* can be represented by the set of all sets of which $X$ is a subset, indicated by $H(X)$. Hence, the explanatory success of *TX* can be represented by $L(t) \cap H(X)$ and the explanatory problems by $L(t)$–$H(X)$. Again, that *TY* is explanatorily more successful than *TX* can now equivalently be defined by requiring either that the explanatory success of *TX* is a proper subset of that of *TY*, or that the explanatory problems of *TY* form a proper subset of those of *TX*. Moreover, some set-theoretic manipulation (Kuipers, 1984, 1989) shows that this definition on the level of sets of conceptual possibilities comes down on the level of conceptual possibilities to the requirement that $Y$–$S(t)$ is a proper subset of $X$–$S(t)$.

Note that it is not difficult to see directly that $X$–$S(t)$ represents the explanatory problems at the level of conceptual possibilities, for every member of $X$–$S(t)$ prevents that the truth of hypothesis $S(t)$ (i.e. that $T$ is a subset of $S(t)$) can be derived from, and hence explained by, the (hypothetical) truth of theory $X$ (claiming among others that $T$ is a subset of $X$).

Now it is plausible to define that *TY* is more successful* (with an asterisc, to indicate the formal difference with the descriptive case) at $t$ than *TX* iff *TY* is instantially as well as explanatorily at least as successful as *TX* and even more successful in at least one of these respects. From the foregoing it follows that this is equivalent to:

*Definition*:
*TY* is *more successful** at $t$ than *TX* iff
$R(t)$–$Y$ is a subset of $R(t)$–$X$
$Y$–$S(t)$ is a subset of $X$–$S(t)$
and at least one of both subsets is a  a proper subset.

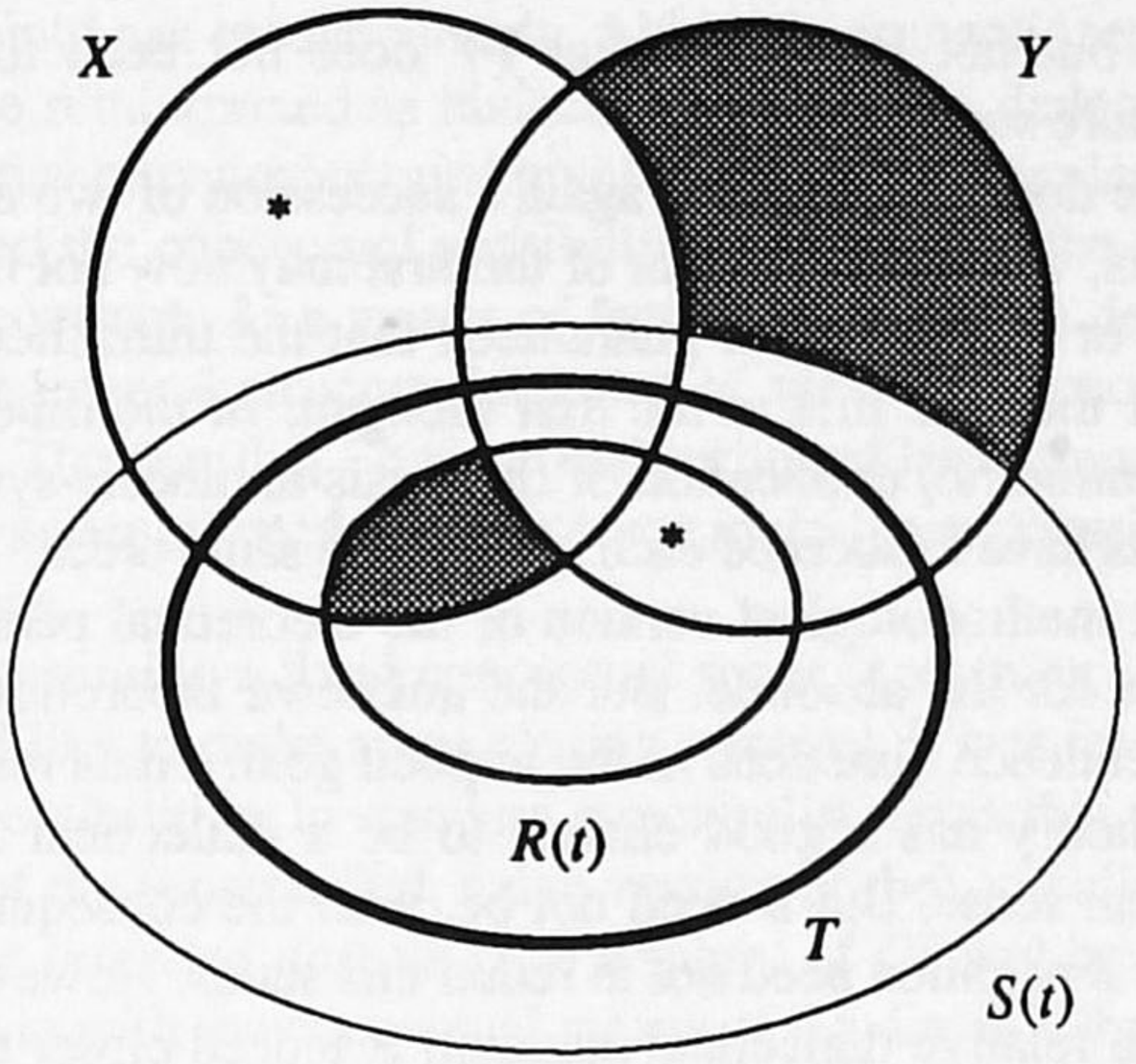


*Figure 4*

The situation is depicted in *Figure 4*, where $T$ is indicated by a bold line. The asymmetric character of theoretical success arises from the different formal roles of $R(t)$ and $S(t)$. The difference between $t$- and $T$-approximation can now be expressed by saying that $t$ is approached from "inside" by $p(t)$ and $Ct$ from "inside" by $n(t)$, whereas $T$ is approached from "inside" by $R(t)$ and from "outside" by $S(t)$. It should be mentioned that under very restrictive, but interesting, conditions it is also possible to formulate on the theoretical level a useful symmetric notion of success (Kuipers, 1982), but the primary notion following from the logic of the situation and known from scientific practice is the asymmetric notion of instantial and explanatory success.

### *4.2.2 Dialectics of Theories on the Basis of Their Success*

Of course we now suggest to explicate the dialectical concepts in terms of the notion "more successful*". The verbal similarity with *subsection 4.1.2* of what follows hides the important difference due to the asymmetric character of the present notion of "more successful*". In this way we get again historized, i.e. data and hence time relative, explications of these concepts. In the light of $R(t)/S(t)$, $TY$ is a dialectical negation of $TX$ iff $TY$ is more successful* than $TX$ at $t$. It is easy to check that also according to this data relative comparative statement $TY$ contradicts $TX$ and incorporates and supersedes its success. Again one may prefer to see it as an explication of dialectical correspondence. The main consequences of the data relative character are that $TY$ does not need to have superseded (the success of) $TX$ always before $t$ (it might have been equal

till some time, but not less), and that *TY* does not need to be able to incorporate the future success of *TX*.

A data relative double negation is again a succession of two data relative dialectical negations, where the moment of the first may now not be later than that of the second. For it is not at all guaranteed that the third theory was already more successful than the first at the first moment. In the otherwise plausible data relative (symmetric) explication of the thesis-antithesis-synthesis-triad the relevant moments have to succeed each other in the same order.

In the present methodological version of the theoretical perspective there is no explicit place for the absolute. But the unknown theoretical truth *T*, apart from its *CS*-dependence, functions as the implicit goal: a data relative dialectical negation of a theory has a good chance to be a dialectical negation in the (epistemo-)logical sense. But it need not be, with the consequence that a data relative dialectical negation need not to retain this status. However, as is easy to check, if the data relative dialectical negation is indeed closer to the truth, and hence is also a dialectical negation in the logical sense, then it had to be always at least as successful* and it will remain more successful* and hence retain its status as data relative dialectical negation in the light of all possible new evidence.

## *5. Concluding Remarks*

The structuralist theory of truthlikeness can be refined in several ways (Kuipers, 1987a, 1987b, 1991). I will mention the most important ones. On the theoretical level it was assumed in the foregoing exposition that all mistakes are equally bad. One plausible refinement consists of implementing the findings on the descriptive level in order to account for the fact that for instance one structure outside *T* may be more similar to a member of *T* than another. In another refinement theories are stratified in the sense that the components of the conceptual possibilities are divided in theoretical and non-theoretical ones. Moreover, it is possible to formulate quantitative versions.

Such refinements may well lead to refinements of the proposed explications of dialectical concepts. As a matter of fact, combining my paper *Truth approximation by concretization* (1991) with the present one, strongly suggests to elaborate (structuralistically represented) "concretization" as as a special, refined kind of dialectical negation or correspondence, in complete harmony with the claims of Izabella Nowakowa (1974) and Leszek Nowak (1977). However, what has been presented will be enough for formally interested dialecticians to decide whether the structuralist theory of truthlikeness can help them to clarify their concepts.

One complaint I can predict already. Although, as mentioned, the dialectics of theories can be reinterpreted as dialectics of concepts, dialecticians will argue that the dialectics of concepts must involve more, in particular the development of what I called the conceptual possibilities constituting the conceptual space, which I kept constant. As a matter of fact Thagard (1982) deals with this problem from the general structuralist point of view (not specifically related to truthlikeness). The fact that I had several technical hesitations about Thagard's paper inspired and motivated me very much to design explications within a fixed conceptual space.

Of course, assuming a fixed conceptual space is a strong idealization, about which I would like to make some closing remarks. *T* was introduced as the set of empirical possibilities. In standard structuralist terms this set is one possible specification of the (unstratified, naive version of the) so-called set of intended applications or *intended domain*. *T* is a subset of *CS* and hence represents the intended domain with the conceptual means of *CS*, i.e. it is the intended domain "as seen through *CS*". It is evident that *CS* is manmade, hence *T*, being *CS*-dependent, is manmade. Hence we subscribe to a fundamental form of conceptual relativity and constructivism. But this need not imply an extreme form of relativism: claims of theories and hypotheses are objectively true or false, for their truth or falsehood depends on nature.

On the other hand we see that the objective character of claims does not imply that the intended domain and the conceptual space (*CS*), and hence the theoretical truth *T*, are fixed beforehand, and that the only task that remains is to formulate a subset *X* of *CS* leading to a true theory claim. As a matter of fact, in practice, the determination of the *intended domain*, the conceptual space, and a subset *X* is a complicated interaction process, guided by the desire to formulate informative and true theories and hypotheses. This process evidently has a dialectical character in the common sense meaning. Unfortunately, it seems difficult to discern general patterns in this interaction process, without making some important idealizations, such as fixing the conceptual space.

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